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THE INTEROCEANIC SHIP CANAL.

MEETING AT CHICKERING HALL.

December 9, 1879.

PAPER BY REAR-ADMIRAL DANIEL AMMEN, U. S. NAVY,

Representative of the United States in the Congress at Paris on

THE PROPOSED INTEROCEANIC CANAL ACROSS NICARAGUA.

Addresses by CHIEF-JUSTICE DALY, and A. G. MENOCAL, Chief-Engineer,
U. S. Navy.

Letters from FREDERIC M. KELLEY, WALTON W. EVANS, C. E., and NATHAN
APPLETON.

Report on the Proceedings of the Congress in Paris, in May, by Rear-Admiral
DANIEL AMMEN, U. S. Navy (See Appendix A).

Views of WALTON W. EVANS on the proposed Canal between North and
South America, dated May 9, 1879, and addressed to M. C. AUGUSTE VON
HERNERT, for submission to the Paris Congress.

Report of W. E. JOHNSTON, M. D., Delegate of this Society to the Paris Con-
gress, dated August 15, 1879, on the Proceedings of the Congress.

THE NICARAGUA CANAL: Extract from Mr. S. B. RUGGLES's Semi-Centennial
Address at New Haven, July 27, 1864.

Among the prominent gentlemen upon the stage were Chief-Justice Daly,
A. G. Menocal, C. E., Signor de Franco, General George W. Cullum, U. S. A.,
Francis A. Stout, William Remsen, Harlow M. Hoyt, William H. Webb, Wil-
liam H. H. Moore, General Egbert L. Viele, Colonel T. Bailey Myers, James
T. Gardner, Director of the New York State Survey, Elial F. Hall, John E.
Body, and Sidney F. Shelbourne.

The formal business of the evening having been disposed of, the President
introduced Colonel T. Bailey Myers, of the Council, who, at the request of
Admiral Ammen, read his paper—the principal topic of the evening.

THE PROPOSED INTEROCEANIC SHIP CANAL ACROSS NICARAGUA.

BY

REAR-ADMIRAL DANIEL AMMEN, U. S. NAVY.

[In the absence of the author, this paper was read by Colonel T. Bailey Myers, who briefly
referred to the topic as follows:]

Ladies and Gentlemen—In fulfilling a duty devolved upon me
by Admiral Ammen, I regret that he could not have been here in

person. An accidental association some years since as members of the Board of Visitors at the Naval Academy, ripening into friendly relations and correspondence, probably induced him to select me to represent him. With no personal interest in the enterprise, I have the highest opinion of his capacity and the value of his opinion. His paper was forwarded before the opening meeting, but was deferred to that of Lord Dunraven, who was in haste to leave the country. It seems proper to make an explanation on behalf of the Council of the position of the Society on the Interoceanic Canal question. Its Hall and Journal have been open for years for its discussion. Foreseeing that all attainable information on the subject would soon be necessary, a committee of the Council, consisting of Mr. Clarence King (Director of the United States Surveys), Mr. Francis A. Stout (Commissioner for the New York State Survey), and myself, by memorial and personal attendance at Washington, urged Congress, last winter, to print the surveys and statistics connected with the Government work on the Panama and Atrato-Napipi routes executed long before. This was only completed in a temporary form in time for the use of the Congress at Paris, and has recently been officially published. Access to it could not be had by the Society before that time, and was refused to individuals. In sending representatives to that Congress, the Society, therefore, claimed to take no part in the decision of an important question, of the merits of which, for these reasons, they could be but partially informed, but only as an appreciation of its importance, and to acquire information. Naturally they could not express an opinion without the time for study of prior details, nor could they expect that their representatives, during its brief and exciting session, should become able to do so. Two of these representatives have since given to the public their conflicting views on the plan presented by M. de Lesseps—Dr. William E. Johnston, residing in Paris, by his able written report to our President, Chief-Justice Daly, received in the vacation, and Mr. Nathan Appleton, in reading at about the same time a paper before the Board of Trade, supplemented by a communication to be read this evening.

Admiral Ammen, as Chief of the Bureau of Navigation, having been charged with the fitting out of the American explorations, and as a member of a commission formed by the Government for the consideration of its plans, having studied their results, has labored under

no such difficulties. Those who know his capacity and devotion to every duty will believe his to be of the greatest value as an educated opinion. Knowing that other conclusions will be advanced, he has authorized me to say that he is prepared to sustain it, and to reply to them if brought to his attention in the public press, that he considers the subject worthy of exhaustive, if competent, discussion.

Of one so important, those present will, it is hoped, patiently submit to an extended discussion, caused by a desire to entertain all opinions, and open its merits to a free investigation. I will now read Admiral Ammen's paper.

THE PAPER.

I am indebted to a prominent member of your Society for the suggestion that I should continue the discussion of the Interoceanic Canal question under its auspices.

I propose for your examination, "The Present Aspect of the American Interoceanic Canal Question."

I shall not tire the patience of my hearers by an attempted history of this subject ; those who are desirous to inform themselves as to what was known and what was asserted prior to 1866, can do so by reading a Report to Congress by Rear-Admiral Davis, U.S.N., published that year under the title of "Interoceanic Railroads and Canals," of course referring to this continent. It contains from pages 31 to 37 the authorities cited ; a large amount of valuable information necessarily interspersed with much that is wholly unreliable, or only of partial value. The elimination of mere assertions and of errors has added vastly to the work of exploration and survey since that time. For an outline as to what has been done since then, I may refer you to my paper of Oct. 31, 1876, and a second, read Nov. 15th, 1878, before your Society.

The first paper was intended to show the errors of M. Drouilet, French engineer, and those who regarded him as an authority, as shown in a pamphlet issued in Paris in May, 1876, apparently with the approval of the commercial branch of their Geographical Society. It was designed to show that there did not exist unknown routes comparable for the construction of a ship canal to those already known. The second paper was to show the feasibility of a ship canal via Nicaragua as a commercial question, and to do this it

seemed to me necessary to establish its superiority over all known points, especially as to economy of construction and permanency of works, from less liability to the destructive effects of floods or other probable causes.

In the month of March last, when our Government thought proper to have our maps and plans, the results of close instrumental surveys on the Isthmus of Panama, and also those known as the Atrato-Napipi route, published for presentation to the Congress called to assemble at Paris on the 15th of May, it was considered desirable that I should go abroad to present them, with such other surveys as had been recently made under its orders.

I suggested that I had been one of a Commission appointed by the President on the 13th of March, 1872, for the purpose of examining into and reporting upon the question of a ship canal across the Continent, and that on the 7th of February, 1876, this commission had made its report as to locality, etc., which had been acceptable to the Government. It seemed to me, therefore, that some other person should be selected to attend the Congress. A second objection was that the selection of the canal route was eminently a question capable of settlement only by the ablest engineers, and those of the highest character. I urged further, that Commander E. P. Lull, of our Navy, who had been engaged on the surveys of Caledonia bay, and south of it, and afterwards had been chief of the parties making the surveys of the Nicaragua and the Panama routes, could well take my place, as he had a rare judgment and capacity, which would enable him to present fairly such work as he had done in comparison with the surveys made under the direction of other officers.

Notwithstanding these representations made by me, I found that the Government preferred my going as a delegate, when of course I appreciated fully the honor, and made such suggestions as seemed necessary to discharge properly the duties which belonged to the position. It seemed to me important that the civil engineer who had been employed on both the Nicaragua and Panama surveys, and who had performed his duties most satisfactorily to the officer conducting them, should go also, either as my assistant or as a delegate, to make the technical development of the routes. The suggestion was carried out, and I may add that, so far as I am aware, Civil Engineer Menocal performed his duties with entire satisfaction to our Government. In presenting important informa-

tion to the Congress, the results of our Government surveys, it seemed necessary that certain ideas connected therewith should be expressed. For that reason, what I shall hereafter call my "Address" to the Congress was prepared, and submitted to the inspection of the department of our Government under whose instructions I went abroad. On arriving in Paris, the day preceding the meeting of the Congress, Mr. Menocal and myself lost no time in paying our respects to M. Ferdinand de Lesseps, too widely and too favorably known to require further comment, unless I may add that then and on all other occasions our intercourse was in all respects agreeable.

On the morning of May 15, preceding the meeting of the Congress, I received a visit from M. Blanchet, an agreeable French gentleman who had been to Nicaragua on two occasions to secure a concession for the construction of a ship-canal, and indeed had one, which last March was rejected by their Senate. I was informed by him that the previous evening M. de Lesseps had either caused a meeting to be held or an agreement entered into that was acceptable to M. Blanchet, and to the party in the Congress who would support the Panama project. My understanding of this was that they had agreed to permit the discussion of the question to stand on its merits, and that which ever side lost the vantage ground, would receive some recompense which had been agreed upon in advance. Once at least during the sitting of the Congress I received a visit from M. Blanchet, who seemed to be very much excited about the question, and to think I should be also. I told him that the decision of the Congress was no concern of mine; that my duties would be discharged by making a fair and full presentation of all the information in the possession of our Government, which was in fact the object of my being in Paris. After the adjournment of the Congress, previous to my leaving, I received another visit from M. Blanchet, who informed me, or at least conveyed the impression, that his opponents had acted in bad faith with him.

On the meeting of the Congress on May 15, an immediate organization was effected, M. de Lesseps being chosen President, with five Vice-Presidents.

The names of the members of the different Commissions were called, as follows: 1st, Statistics; 2d, Economic and Commercial; 3d, Navigation; 4th, Technical; 5th, Ways and Means.

After naming the members of the Commissions M. de Lesseps remarked in a jocular manner that our work was all cut out, that many of the delegates were anxious to get home, and that we could carry the work through *à l'Américaine*, which may be translated *with a rush*. The full meeting of the Congress was then adjourned until the 19th; the Commissions met at 9 o'clock the following morning.

Owing to the non-arrival of our heavy package of books, maps, etc., I was not able to present them the next day, as desired, but did so on the morning of the 17th to the Technical Commission. On their presentation I stated that I would have my remarks printed in French and English. The following day copies were in the hands of the Secretary for distribution to such persons as wished them. The address was as follows:

GENTLEMEN : The Government of the United States has conferred upon me the honor of presenting for the consideration of this learned and distinguished body several surveys, recently executed by its order, a part of them published only within the past month. In their order from the North to the South, they are as follows :—

1. The survey of the Isthmus of Tehuantepec, by R. T. Shufeldt, now Commodore U. S. Navy.

2. The survey of what is known as the Nicaragua route, an actual location of an interoceanic ship canal, with several tentative lines, by Commander E. P. Lull, U. S. Navy, assisted by Civil Engineer A. G. Menocal, U. S. Navy.

3. The survey of what is known as the Panama route, an actual location of an interoceanic ship canal between Aspinwall and Panama, including feeder, etc.

4. The report of the surveys made by Commander T. O. Selfridge, U. S. Navy, extending from the Gulf of San Blas on the Atlantic and the Bayano or Chepo river on the Pacific coast to the mouth of the River Atrato on the Atlantic, to the Gulf of San Miguel on the Pacific coast, involving many tentative lines, and thence following up the River Atrato 150 miles, and from thence up the valley of the River Napipi, known as the Atrato-Napipi route, and terminating on the Pacific coast at Chiri-chiri.

5. An actual line of location for an interoceanic ship canal, of what is known as the Atrato-Napipi route, terminating as before at Chiri-chiri, by Lieut. Frederick Collins, U. S. Navy.

Maps, plans and calculations for material and labor on a common basis of cost are made for the "Nicaragua," "Panama," and "Atrato-Napipi" routes, as located, affording a ready means of finally considering the relative cost of executing the work on the several routes.

On the 13th of March, 1872, the President of the United States appointed a commission whose duties were "to examine and consider all surveys, plans, proposals or suggestions of routes of communication by canal or water communication between the Atlantic and Pacific oceans, across, over or near the Isthmus connecting North and South America, which have already been submitted or which may hereafter be submitted to the President of the United States during the pendency of this appointment, or which may be referred to them by the President of the United States, and to report in writing their conclusions and the result of such examination to the President of the United States, with their opinion as to the possible cost and practicability of each route or plan, and such other matter in connection therewith as they may think proper and pertinent."

A final report was made by this commission on the 7th of February, 1876, copies of which are furnished for the consideration of this Congress. It was composed of the Chief of Bureau of Engineers, U. S. Army, the Superintendent of the U. S. Coast Survey, and the Chief of Bureau of Navigation, U. S. Navy. It held its sittings at various times and considered all of the information then existing, and concluded that the various surveys and reconnoissances extending over the wide region involved were sufficient to arrive at a conclusion, except in the region lying in the vicinity of the Panama railroad; it therefore requested the Government to have a survey made and an actual line of location for an interoceanic ship canal on the best route found practicable in that region, which was done without delay. The Government, at the same time, thought it advisable to have a more thorough examination and actual location made along the entire length of what is known as the Atrato-Napipi route. After a careful study of these surveys, maps, plans and estimates, in addition to the information which was previously before it, the commission made its final report, before alluded to.

In the consideration of a great work, such as the construction of a ship canal across the American continent, we may well suppose that its permanency should be regarded as important as the selection

of the route itself, involving the least cost of construction with the minimum of problems of doubtful cost in the execution of the work. With these points assured the question becomes fairly debatable, whether the physical conditions are to be considered too formidable to admit of the execution of the work, as a commercial or monetary question—in fact, whether a grand idea for the amelioration of the great commerce of the world can be put into execution, or, perforce, must be abandoned, through the existence of obstacles too formidable in their nature to admit of an endeavor to overcome them.

Should it be considered, after a careful and minute examination of the question, that a commercial or monetary success is practicable in the construction of an interoceanic ship canal, whatever error may obtain by the selection of an inferior route through a misapprehension of conditions of permanency, or of first cost of construction in the location of the ship canal, would work a double injury, in the failure to yield a proper dividend, by reason of unexpected and extraordinary cost in construction, through constant demands for heavy expenditures in the endeavor to keep the canal navigable, and in the probable imposition of tolls, which would tend to drive away or fail to secure a considerable part of the tonnage which should naturally pass through it. This would make the ship canal appear rather as an obstructor than the promoter of a world-wide commerce. I feel sure that these considerations will have weight in the mind of our distinguished President, at whose call this assemblage has met, to whose genius and indomitable energy are due the inception and the completion of the Suez Canal.

I shall leave to my able associate, Civil Engineer A. G. Menocal, U. S. Navy, a minute presentation of the surveys upon which he was engaged—namely, what are known respectively as the “Nicaragua” and the “Panama” routes. His note-books and other data will show that the plans and estimates are based upon substantial and sufficient information.

There are certain comparative conditions affecting the execution of the work on the three different lines, upon which we give maps, plans and estimates, which it is important to bear in mind in the consideration of the subject of the construction of a ship canal.

In respect to the Nicaragua route, it may be said that the rainfall is comparatively small. Our observations at Lake Nicaragua, extending over one year, show an annual rainfall of 48

inches, or 1.22 metres.* There is a distinct dry season of between five and six months, when work in progress would not be delayed or injured, and but little interruption need be apprehended in the rainy season on that portion of the canal between the lake and the Pacific, as the rains generally fall at night, with occasional showers during the day.

There is abundant good stone, hydraulic and other lime, wood and bamboo, which latter may be found very advantageous in the construction of harbors.

There is a considerable population, well disposed, and when they can have remunerative employment, fairly industrious. The country has an abundant cattle supply of good quality for food, and other productions which would furnish the main subsistence for laborers on the canal, with a convenient water transportation in general along the line of ship canal as located, and lake communication with an extensive, populated and fertile region. This water communication can be greatly increased by the construction of a six-foot canal to Lake Managua, at an inconsiderable cost, and when completed it would make the supplies of all kinds superabundant. Between Lake Nicaragua and the Pacific, near the line of the projected canal, several passable roads exist, and whatever other roads might be required over this short distance could readily be made at inconsiderable cost.

There is an inexhaustible water supply in the lake of 2,800 miles of superface, which equalizes floods and makes the daily changes small in the discharge of the River San Juan, by which it debouches into the Caribbean sea.

It has an excellent harbor on the Pacific coast at San Juan del Sur, convenient for anchorage as Brito itself would be if improved as a harbor, inasmuch as the vessel in transit would have time to regulate her steam and be pointed fair to enter the canal at any assigned time. This reduces the necessity of a harbor at Brito to simply securing a perfectly smooth entrance to the canal.

Lake Nicaragua affords every facility for an interchange of cargoes that may be desired.

The western coast and valley of the lake are, as compared with

* Observations since collated, extending over 1851, by Childs, and 8 months by Lull, 1873, give a mean 82.65 inches.

the eastern slope, comparatively healthy, and upon the eastern slope a considerable part of the labor can be done by means of dredging machines.

The approaches to both entrances are superior in advantages to those of either of the two other routes with which the Nicaraguan is compared.

These considerations would seem to warrant the belief that cost of construction, including material, would be far less than upon either of the two other routes compared, as will be more fully shown hereafter.

The Panama route is next to be considered.

The mean annual rainfall at Aspinwall in a series of seven years is found to be 124.25 inches, or 3.15 metres. A dry season exists, but it is limited to two or three months, lessening the effective time for labor and of comparative healthfulness of the laborers employed, the wet being the sickly season.

No building material suitable is known in that region. The ties and railroad telegraph poles on the Panama railroad are brought from Carthagena or elsewhere.

The population is inferior to Nicaragua, as, also, the country, in ability to furnish subsistence for a large number of laborers.

By means of the railroad already constructed, a canal under construction would have a convenient transportation at whatever cost might be agreed upon.

The cost of the feeder and adjuncts, and other disadvantageous features (notwithstanding the shortness of the line), as shown by maps, plans, and estimates, make a total of \$94,511,360, against that of the Nicaragua route of \$65,722,137 *on a common basis of cost of material and labor*. In Nicaragua the material is near at hand, and subsistence abundant, while on the Panama route, or in its region, there is no material for construction, inferior subsistence and less favorable climatic conditions for labor, as before stated.

The last proposition which remains to be examined is in favor of the Atrato-Napipi route.

Although the mean annual rainfall here is not known, there is no doubt that it is largely in excess of the rainfall at Aspinwall. There is only a nominal dry season, as at any time a precipitation of several inches is likely to occur, and actually does occur many times yearly during the so-called "dry season."

The building material supposed to be available is confined to wood. Population is so scant as to be unable to furnish either assistance or subsistence for even an inconsiderable number of laborers.

The River Atrato would furnish transportation to the mouth of the River Napipi. Along the line of the projected canal the country is alternately rough and covered with swamps, so that great labor would be necessary to construct roads to secure even wagon transportation for subsistence and material for construction.

Under such conditions the projected feeders requisite would be made at great additional cost, as well as the projected tunnel and locks. In dimensions the projected tunnel is as follows: length, 5,633 metres; height, 35.96 metres; width, 18.29 metres.

On the Atlantic slope there are twelve projected locks of 3.14 metres lift, and on the Pacific slope ten of 4.54 metres lift, the summit level being 43.59 metres above mean tide.

With the view of having a definite comparison, the estimates for material and labor, so far as they are identical, were made on a common basis with Nicaragua. The cost on this basis is given as \$98,196,894; but it is quite apparent that with the lack of material convenient, and of subsistence and transportation, as well as the absence of a dry season, and above all, the impossibility of making even an approximate estimate of the cost of a tunnel under such conditions, that the actual cost of the execution of the work would be far in excess of the estimate.

The same physical conditions—the absence of a dry season, and a general lack of material for construction, except wood, and the lack of subsistence—were found to exist by all of our parties, at various times, on what is known properly as the Isthmus of Darien, and of all the region lying south of it.

The long period of time over which the surveys of the United States have been prosecuted, designing to elucidate the problem of an interoceanic ship canal, indicates a persistent interest in this subject. I am happy to add that the present chief magistrate and his cabinet are fully alive to the benefit to be derived from a full consideration of the construction of an interoceanic ship canal, now that further researches of the topography of that region no longer promise a commensurate reward.

The people of the United States will look with great interest upon the discussions and deliberations of this distinguished convo-

cation, and to suggestions which indicate the means that may be adopted to secure a speedy commencement of the work of an American interoceanic ship canal on such a basis as should assure its uninterrupted prosecution and early completion. It would seem that this object could best be accomplished by making the work actually International, could a proper and satisfactory basis of coöperation be arrived at.

The people of the United States recognize the great amelioration and benefit that the commerce of the world would derive through the completion of this great work, and are not disposed to regard the consideration of this subject solely with reference to the degree in which the commerce and the interests of the United States will be relatively benefited through its construction, as compared with the advantages that may accrue to other commercial nations. Such a ship canal cannot fail to be a great and common benefit, especially in opening a rapid and easy transit between the Atlantic coasts of Europe and America and the western coasts of America, and by the speedy development of Australia. Regarding this interoceanic ship canal when completed as the greatest possible artificial highway that can be constructed, conferring benefits on all nations and peoples, the people of the United States consider its construction as something of common interest, and the guaranty of its neutrality a duty in common to all nations.

The presentation of maps, plans, etc., was followed by a technical exposition of the Nicaragua route by Civil Engineer Menocal. Afterwards, in answer to inquiries, he gave the methods of proposed improvement of the harbor of Greytown and the regimen of the bar, as observed by him during several recent visits to that locality. I may add here properly, that the able sub-commission subscribed to the efficiency of the proposed method, and as well to the method proposed for constructing the dams across the San Juan. Several engineers of note at that time not favorably disposed to the Nicaragua route, made many inquiries, with the view of developing its difficulties and its inferiority, and became so well informed as to adopt it as the route offering relatively the fewest difficulties, and in the end *certainly of execution*. These engineers were found afterwards among those who abstained from voting.

On the second general meeting of the Congress, May 19, Sir John Hawkshaw, of England, whose reputation as an hydraulic engineer is second to none, was present. The afternoon was taken up in a desultory discussion of the Panama route by Lieuts. Wyse and Reclus, of the French Navy. A considerable part of the discourse was directed to the Nicaragua route, *which was not then under discussion.*

The data upon which these plans were constructed was quite insufficient. The cause of the anxiety of Lieut. Wyse, when in the United States two months before, to obtain tracings of our maps and plans, became at once apparent. They were not furnished, because it was considered improper to give them publicity abroad in advance of their publication at home.

It will be remembered that previous to last autumn, after making an examination of the valleys of the streams falling into the Bay of San Miguel in 1876-7, and visiting that region the following season, Lieut. Wyse made plans and estimates for two routes, calling the one preferred by him the Tuyra-Tupisa route, which by his report was supposed equal, or nearly so, to any that had been developed through our surveys. This line seemed to me hopeless, from the existence of the gravest difficulties, some of which I mentioned in my paper of November last. It seems, from what I shall presently quote, that Lieut. Wyse had the frankness to inform the Society for which he was acting that in his view a ship canal across that region was impossible. He did not present it at all in the Congress, but took up the Panama route on whatever information he had, and developed it for a ship canal *à niveau*, which certainly was a step in the right direction. It may be said without dispute, that for a canal at the ocean level the line from Panama to Aspinwall is far preferable to any other. The *possibility* of it must be considered simply in a commercial sense, as a canal, wherever made, must have that condition. The following day, May 20, Civil Engineer Menocal was invited to explain the plans and estimates of the Panama route, but was so interrupted by questions that Sir John Hawkshaw suggested allowing him to proceed, and submitting questions afterward.

He stated that when Commander Lull and party began the survey of the Panama route there was no pre-occupation as to what height above the sea, if any, would be selected as the summit level. They

found at Matachin that the floods of the river passed some five or six feet over the railroad track, and that at low water the surface of the stream was forty-two feet above the ocean level. In considering the question it became apparent that if the ocean level were adopted, an excavation would be necessary, making the normal surface of the proposed canal forty-two feet below the present low water, in the river, which would then make a small cascade, and in periods of floods would be transformed into a cataract of one hundred and sixty-one thousand cubic feet per second, of a height of nearly seventy-eight feet, the decrease being due to the measure of the velocity of the water as it approached the precipice, and also to the head of water above the ocean level after falling, which would give a corresponding velocity on its course to the sea. It was apparent that either this great volume of water must be received into the canal from an elevation which would make the effect destructive, or that it would be necessary to "lock up" so as to permit the floods to pass beneath the aqueduct, thus bringing the surface level of the water in it to an elevation of one hundred and twenty-four feet above the sea. This was found to entail the construction of a feeder, with its adjuncts, at a cost of \$9,942,727, with either a doubtful or a scant water supply during a portion of the seasons of unusual drought.

On concluding, Mr. Menocal stated his willingness to answer questions, without eliciting any more.

On the 21st another general session was held. Sir John Hawkshaw gave his opinion on the Panama route as follows:

"With regard to the question whether the canal should be constructed with or without locks, the following points occur to me:

"If the canal is to be without locks its normal surface level would be that of the sea, and its bottom level, say eight meters lower.

"This being the case, the canal would receive and must provide for the whole drainage of the district it traversed.

"Therefore it would be necessary to ascertain the volume of water that would drain into the canal before it would be possible even to determine the sectional area of the canal.

"If the canal have a less surface fall than the river, as it would have, it must have a larger sectional area to discharge the same volume of water.

"The average section of the river in a flood at Mameï was ascertained by M. Reclus to be 1,310 square metres. This would require a canal, if it were eight metres deep, to be 160 metres wide.

"The waters of the Chagres would have a tendency to flow towards the Pacific, that is, through the tunnel, as the distance is less and the fall greater than to the Atlantic.

"It seems to me that the dimensions of the tunnel, if it has to serve for both the river and canal, would be too small. Mr. Menocal's estimate of the volume of the Chagres in time of flood would much more than fill the tunnel; and in any case the whole section of the tunnel is only half that of the river in time of flood, as given by M. Reclus.

"During the construction of a canal at the sea level, difficulties would arise in providing for the drainage, which would affect both time of execution and cost to an extent that could hardly be ascertained in advance.

"If, from such considerations as the foregoing, it should be concluded that the canal should be so constructed as to retain the rivers for natural drainage, then recourse will have to be had to locks. In that event there can be no difficulty, in my opinion, in carrying on the traffic with locks properly constructed, provided there is an ample water supply, which would be a *sine qua non*."

It will be observed that Sir John Hawkshaw expressed the axioms heretofore acknowledged by able engineers : to avoid surface drainage, and to have an abundant water supply. After reading his opinion, he remarked that a residence of two or more years in Inter-tropical America had given him a knowledge of how these showers behave, without which he might think differently. In a conversation with him before he left Paris, after two days' attendance at the Congress, he expressed to me the opinion that the canal could not be excavated *à niveau*, and if it were that it would be filled up with trees and silt.

A pamphlet by M. Dauzats, Chief Engineer of the Suez canal, compares that work with the various routes proposed across this continent. He quotes at length from my last paper read before this Society showing the marked contrast of physical conditions, the region of the Suez canal having a mean annual rainfall of less than two inches, whilst the region of the Panama canal has a rainfall of one hundred and twenty-four inches. His deduction is that surface

drainage falling into a canal, has a scouring effect which is beneficial, whilst the abrasion of the banks of a canal is far more destructive.

Were it not too great a tax on your patience, I would point out the fallacy of such an argument. It is assumed that when a river like the Chagres is dredged, it will change its regimen. This deduction is necessary to a supposition that a canal *à niveau* at Panama is possible.

On the afternoon of the 19th, the Technical Commission was divided, one part to report upon the practicability of locks as presented on the Nicaragua route, the other to consider the question of making tunnels for navigation. There was confusion and violent action, I was informed, on the part of Lieut. Wyse, growing out of his opposition to Mr. Menocal being put on the sub-commission on locks. Mr. Menocal very properly asked to be excused.

The report as to locks was, that they could be made to serve their purpose. The calculations for a tunnel were made for construction on a dry foundation ; it was stated there were no elements of calculation for building a tunnel below the sea level, as the plans demanded.

During the sittings of the Congress, I found myself frequently obliged to dissent from the propositions of Commander Selfridge, U. S. Navy, who strangely enough was found in the Congress without being named by our Government. This officer had been the chief of large parties who were engaged during the seasons of 1870, 1871 and 1873, in examining the coast lying south and east of the Panama route, at San Blas, Caledonia bay, the streams flowing from the flanks of the mountains adjacent to the Bay of San Miguel and of the counter slopes falling into the Atlantic ; also in making an examination of the Atrato-Napipi route for a ship canal, which will be found in his report to the Secretary of the Navy, June 12, 1873.

I refer the curious reader to pages 66 to 70 inclusive and to map VIII, illustrative of the Atrato-Napipi route as developed by Commander Selfridge. Nobody reading this report and referring to the drawings would suppose for an instant that the greater part of it was purely imaginary, the ground lying between the rivers Atrato and Doguado never having been passed over by Commander Selfridge or any of his party. It is delineated as an inclined

plane, locks located and sections of elevations given in figures ! Between this fanciful presentation and the profiles made by Lieut. Collins, U. S. Navy, there is a very wide difference. I quote from page 7 of my report :

“Commander Selfridge then said that the remarks made by Sir John Hawkshaw in relation to the Chagres River were not applicable to the Atrato-Napipi route, and endeavored to enter into a further discussion of its merits. I stated that I would suggest the advantage of discussing the carefully prepared plans of Lieut. Collins along the lines of actual location, which were the best that could be found in months of labor, instead of lines drawn at will by Commander Selfridge, involving uncertainty of execution and an entire absence of elements of calculation, as every engineer would recognize.”

This was one of several occasions that I had to suggest the advantage of discussing facts instead of indulging in fancies calculated to deceive the credulous and unwary, and absolutely a waste of time.

The proceedings of the general Congress on the 23rd, and in the Technical Commission on the 26th, are so significant that I shall append them without omissions.

By reference to the Appendix it will be seen that the partial quotations which I shall use do not present a perverted meaning. I will submit the question to every reader of the Appendix, whether, free from any comment, it is not patent that the Congress was not called to decide upon the best routes for an interoceanic ship canal, but only upon what was *possible* via Panama.

M. de Lesseps announced : “That which struck us most, is the enthusiasm of the United States of America in favor of the establishment of a canal at Panama.”

We may ask with surprise, when and where was this enthusiasm manifested ? I saw nothing of it, nor was it conveyed by the Government of the United States, in sending me to present the plan for Panama, and to submit the other surveys and reports made under its orders. I again quote M. de Lesseps: “Lieut. Wyse and his companions have rendered us an account of the mission that they undertook. Seven of them set out; four are dead in those wilds, where one is only able to effect a passage with a hatchet in the hand.”

“They have then returned, and have had the honesty to declare to us that in their view a canal was impossible in the regions that they had returned from exploring.” This seems sufficient to dispose of the historical sketch of M. Hertz, given on page 10 of the proceedings,

as follows : " The French Committee of Study for the Interoceanic Canal [in consequence of the completion of the surveys alluded to by M. de Lesseps,] thus found itself able to submit to an Interoceanic Canal Congress a collection [of information] upon which it would be able to pronounce intelligently. It is known with what alacrity the most learned men from all countries have responded to the call." To show the sufficiency of our information previous to these surveys of Lieut. Wyse, was the object of my paper, read Oct. 1876, in reply to a pamphlet of M. Drouillet, who came to this country to obtain assistance in making further surveys. The closing paragraph of my paper was as follows : " I may add as a personal conviction, that however long and seriously the search may be continued for ' results ' by surveys, nothing can or will be developed so advantageous as that which the surveys of our Government present for your consideration." Lieut. Wyse's survey undoubtedly destroyed preoccupations in Paris, and so far was useful to them ; which they might have effected at less cost by a more thorough examination of the work that had been done by our Government.

Notwithstanding what M. de Lesseps said respecting the assertions of Lieut. Wyse as to the impossibility of a canal in that region, we find in Lieut. Wyse's last report a tabulated statement of routes, among which is the Tuyra-Tupisa, at an estimated cost of 600,000,000 francs. I quote again M. de Lesseps : " I have consulted M. La Valley, and he has replied that it (would be) decided for a canal *à niveau*,—that it was a public sentiment. I will permit myself to sustain that opinion." Again : " M. La Valley has studied the question of a tunnel; he believes it certainly possible." He says, " it is only a question of cost."

This Society will be surprised to find, on reading all that M. de Lesseps has justly said of the high qualities of M. La Valley, as given in the Appendix, that when the resolution was voted on, he, as also some other distinguished engineers of the French Society, were designedly absent. To the fact that these eminent engineers have not given the sanction of their names to what, by others, was regarded as *possible* in engineering, is probably due the discredit shown to the decision of the Congress.

I quote again M. de Lesseps : " In my belief we should not make a canal with locks at Panama, but a canal *à niveau*; that is, I believe, the opinion of the public, of which I am the organ at this moment."

Here we see that, instead of studying the question as an engineer, and in its economic conditions relatively with other routes, M. de Lesseps pronounces himself to be the organ of what he believes to be public opinion. Happily for the public, its supposed demand could not swerve M. La Valley and others of great reputation.

I call attention to the remarks of M. Peralta, as given in the Appendix. This learned and able Minister of Costa Rica to our Government is well known to many of you personally. His suggestions were not to be considered. M. de Lesseps wished nothing more embodied in the resolution than whether a canal *à niveau* via Panama was possible.

The resolution was passed as he desired by such a vote as to call forth an expression of his satisfaction—this, too, supported by the demands of public opinion, as he stated—and yet he is not happy.

I again quote M. de Lesseps: “Since 40 years I have studied the question of the Suez Canal. I have always understood that, for a profit, it is necessary to receive at the least 10 francs per ton. One can perfectly well make the American canal pay double that amount whatever project may be brought about. These are considerations that one is very glad to know for the future.”

The humanitarian idea so nicely held out, and especially supported by M. Simonin, is dropped. There remains alone the idea of constructing a canal without reference to whether it is on the best location, but certainly on the line where the concessionists are entitled to receive, by the terms of the concession, 10 per cent. of the stock issued.

The Report of the Commission on Statistics of the Congress gives the tonnage likely to pass through the canal, as follows:

That of the United States.....	2,000,000 tons.
That of Great Britain.....	1,050,000 “
That of France.....	356,000 “
That of all other Powers.....	356,000 “

In the Bulletin du Canal Inter-Océanique of October 1, published in Paris, in the building of the Suez Canal, there is an article of some length, entitled “Via Nicaragua,” in which is set forth in varied terms the egotism of the American Commission on the inter-

oceanic canal Question, as shown in their Report to our Government, and also the same quality shown by our official delegates to the Paris Congress.

If this 'egotism' was shown, as is supposed, in the report, it was simply in the endeavor to promote the public interests in the most economic manner. The narrowness of the views of the Commission is supposed to be shown in recommending lockage for vessels of only four hundred feet in length, and a beam much greater proportionately than that given vessels at this time. Without having the time or patience to look up the French steamers, I will venture the opinion that all of them longer than four hundred feet could be counted on the fingers of one hand.

The 'egotism' of Mr. Menocal and myself at the Paris Congress, so far as I am capable of judging, was confined to a fair presentation of all of the information in the possession of our Government, feeling no very lively interest in what the Congress would *decide*, not *determine*, which belongs to nature, and to the keen appreciation of moneyed interests as to what will and what will not pay. After the adjournment of the Congress an engineer very much in the confidence of M. de Lesseps said to me, "Now that the matter was settled, what amount of money might be counted on in America to promote the enterprise?" I replied that, in my opinion, they would not get a dollar. Evidently, in my 'egotism,' I was wrong—to what extent will only be known when the Bulletin devoted to the canal interests publishes the amounts subscribed in France and elsewhere for the construction of the canal *à niveau*. Without assuming to speak for the public, I feel sure that such a statement would be read with interest.

Looking at the table just given of the tonnage of the different nations, we see the 'egotisms' (interests?) of all of them in form and substance. In the matter of the canal, the interests of the United States now are practically double those of Great Britain, and will become relatively greater, proportionate to the increase of population. Those of France are, roughly, one-third of Great Britain, and yet, if the word *egotism* is a proper substitution for the word interests, she has as much as all the rest of mankind.

In an interview given in the New York *World* of Oct. 9, M. de Lesseps is reported to have said: "If I may say so, I do not think the Americans are very clear-sighted in this matter. They are of

the Anglo-Saxon race, and it is, to some extent, a question of race. The Anglo-Saxon race is unequaled for its power of dealing with the circumstances immediately before it, but I do not think it sees very far in the future. The Latin race has a somewhat wider intellectual horizon."

He regards the Anglo-Saxon race as eminently practical, and without being of it, I can well believe him. Granting his foreseeing power, may we not ask the probable number of Anglo-Saxons on this continent at the end of this century, and at that time, also, of those inhabiting Australia and the Pacific islands? Awaiting this reply, may we not without egotism assume it to be roughly one hundred millions of people? We can leave to M. de Lesseps, with his long view, the contemplation of the end of the next century, the period A. D. 2000. Still, even to our obscured vision, there seems a mighty multitude of men; shall we give it shape in supposing it to number at the least 300,000,000?

Dropping the consideration of humanitarian ideas so unhappily dispelled, and looking at it as a plain business matter, could we not submit the question to the citizens of the two powers first named, whether it would not be worth while to consider the construction of a canal on a *commercial basis*, and with reference to a careful examination of all of the points involved; and if found practicable in that view, do the work, and if otherwise, develop through the United States and the Canadas such additional railroads as would ameliorate the commerce of which they are so largely the factors?

After considering the proceedings of the 23rd in the general session and a part of the proceedings of the Technical Commission of the May 26, as given in the Appendix, we can proceed to consider the vote more intelligently. A resolution was introduced to conform to the wishes, as expressed, of M. de Lesseps. It is as follows:

"The Congress considers that the piercing of an Interoceanic Canal at a constant level, so desirable in the interests of commerce and navigation, is possible, and that a maritime canal, to respond to an indispensable facility of access and utilization which a work of this kind should offer, should be located between the Gulf of Limon and the Bay of Panama."

The official vote, as given in the proceedings, is as follows: Absentions, 12; against the resolution, 8; in favor of it, 78. The most significant figure is omitted. As counted up on the record, 36

were *absent*, among whom were a considerable number of engineers of note, and perhaps half a dozen delegates who were not in attendance during the session.

Had it not been that the expression of my absence from voting was regarded as an "enigma" which has been *solved* in the Bulletin of October 1, I would not have alluded to it. I abstained from voting, on the ground that "only able engineers can form an opinion, after careful study, of what is actually possible, and what is relatively economical, in the construction of a ship canal." I feel sure that it will excite a smile among us to suppose this in any degree enigmatical, and may recall the ideas so ludicrously shown in the comedy of the Irish Ambassador.

In relation to the vote and to the delegates, a pamphlet published in Paris, titled "Panama, 400,000,000 à l'eau," gives the following:

"Let it be remarked that one-half of the members of the Congress were French; they had been chosen by the organizers of that assembly; 34 members belonged to the Geographical or the Society of Commercial Geography of Paris. What was their competency to decide between a canal with locks or on a sea level? Fourteen other members were engineers or assistants of some sort on the Suez canal. What was their impartiality to decide between M. de Lesseps and others? And, among the others, if one takes count of personal friendships, and of the prestige exercised by a great name, how many more will remain?"

No one will deny that among the French delegates to the Congress were men eminent in every branch of engineering science, and others of the highest character as men of science; the same may properly be said of the foreign delegates; they were men of character and special attainments, usually having relation to the subjects that would concern a canal, if not its construction.

As regards the engineers of Holland and Belgium especially, where the land is so flat and the rainfall so small, their practical experience of a head of water would be confined almost to tidal action. However able they may be, they had not, so far as I know, the practical experience of Intertropical America that made Sir John Hawkshaw so competent an authority.

Engineers in other branches would naturally adopt the opinions of the hydraulic engineers, and, so far as their consciences would permit, be disposed to support the opinions and wishes of M. de

Lesseps, especially if expressed emphatically, as found in the Appendix. They would say very properly, the *execution* of the work was for M. de Lesseps, and not at all their affair. He had asked them to say that the canal *à niveau* was possible, and they had obligingly done so. He did not think it worth while to ask his honorable *confreres* if they thought Panama the best canal route; indeed, it would not have been prudent to do so, as he had determined that the canal should be built at Panama, *à niveau*; as expressed by an engineer very much in his confidence, "If they found it possible, the first thing was to get the money; the next was to build the canal in the best manner that they found possible." Even a great general needs the "sinews of war;" the public who made the demand through M. de Lesseps to have a canal *à niveau* should not desert him so cruelly; he has met them fully half way in reducing the cost of construction one-half as given by the Congress, and in still further shortening the time for the construction of the work as given in his provincial tours, beyond that assigned by him in the Commission on the 26th, as shown in the Appendix.

I do not propose to discuss the terms of the concession fully, as found on page 281 of the report of Lieut. Wyse. I will point out some features that seem to me objectionable in the extreme.

The Canal Company agrees to transport, gratuitously, all persons in the civil and military service of Colombia, their baggage, arms and ammunition, and if the company is not provided with vessels suitable for their transportation, to pay their passages, and for the transportation of armaments and ammunition.

The Government of Colombia is to receive semi-annually five per cent. of the gross receipts of the company for the first 25 years, six per cent. for the second 25 years, seven per cent. for the third 25 years, and for the remaining 24 years eight per cent., at the end of which time the canal reverts to the Colombian Government.

The Company is "authorized to reserve ten per cent. of the shares for the benefit of the founders and aiders of the enterprise."

The only hope for a stockholder would seem to be in the extraordinary impost of ten francs per cubic metre, not on the gross tonnage or weight of the vessel and cargo, but upon the cubical contents of a paralleliped represented by the length, breadth and draught of the vessel! Lieut. Wyse supposed that this measure-

ment might amount to 30 francs per ton, which, if imposed on ordinary cargoes at ordinary prices, as wheat, would make a voyage from San Francisco around Cape Horn preferable in economy.

Looking at the terms of the "concession," as it is called, and the whole matter from beginning to end, the wonder is that the subscriptions were so large, rather than that they were so insufficient for the purpose of constructing a canal.

When Lieut. Wyse was before a Commission in the Congress he was questioned as to the Panama Railroad and its franchises, and replied that he had made a satisfactory arrangement, by which the Canal Company would gain two millions of francs yearly, but gave no further explanation as to the arrangement.

So far, in general, we have been regarding the aspects of the interoceanic canal question from other points of view than our own, with occasional objections or remarks thereon. Let us now look at the question from our point of view.

After the adjournment of the Congress it seemed to me that its high authority, and that of M. de Lesseps, who does not in the interview overstate the confidence with which he has been regarded in France, would deprive many peasants of their hard earnings; what kind angel protected them Heaven only knows. So far as the English and our countrymen were concerned, the decision of the Congress did not seem to me likely to inflict injury, other than a delay and an uncertainty as to the time of commencement of a great work.

In my report to the Secretary of State, which many of you have doubtless read, I made the following deductions relating to the Congress:

That personal interests, arising from a concession for the construction of a canal, are unfavorable to a relative consideration of natural advantages as between two or more routes; that such personal interests did exist was quite apparent from first to last; and the "concession" was frequently partially discussed or alluded to, especially in the committees or sub-committees.

That the discussion in Paris has shown that hereafter in the examination of the question only the Nicaragua and Panama routes need critical examination, and that sufficient information exists as to all other routes.

That the canal *à niveau* by the Isthmus of Panama, either with or without a tunnel, has been shown to be hopelessly impracticable, if considered as a commercial question.

That a general and special knowledge now exists among European engineers relative to the subject of a ship canal across the American continent, which did not exist prior to the assemblage of the Congress in Paris.

In view of actualities, it seems proper that the Government of the United States should consider the question of the interoceanic ship canal as still undetermined, notwithstanding the report of its commission on the subject ; which has received acceptance by the people of the United States, and by our able civil engineers, inasmuch as it has not received a criticism.

Should this be regarded as advisable it would seem necessary to form a commission of the ablest engineers of our army, and to invite the ablest civil engineers of our country, and as well invite all the governments who were represented at the congress in Paris to send their engineers, all to join in full discussion, and having equal powers, with the view of removing it from all extraneous influence of "concessions," or other objects than the consideration of the construction of a ship canal across this continent, capable of fulfilling the demands of the world's commerce, under the most economic conditions.

I have learned that the suggestion as to a commission was maturely considered by our Government, and was regarded as unnecessary, in view of a supposed unanimity of the people of the United States in favor of the Nicaragua route.

It seems to me, however, that this fact, which I think undoubted, does not do away with the great advantage of the discussion of the subject by the ablest engineers ; especially if, after a close study of the Nicaragua and Panama routes as presented by the surveys, they should visit both localities for the purpose of verifying any part of the work desired, and of the existence or non-existence of material for construction, and the methods which could best be employed in the execution of the work. This done, so far as human action can go, the question will be presented with the least possible condition of error—the locality where the canal should be made, or whether a canal should be made at all.

When it seemed to me that our Government was not disposed to call a commission, I wrote, at the suggestion of a gentleman of position and influence, to Sir John Hawkshaw, presenting the advantage that the subject would derive from a personal inspection of the Nicaragua and Panama routes, either by him or some able engineer appointed by the Society of Civil Engineers of Great Britain, accompanied by another appointed by the Society of Civil Engineers of France, and also another by our own Society, or, if our Government thought proper to detail Gen. Weitzel, U. S. Engineers, or any other competent officer who has had large experience in hydraulic works. As yet I have received no reply.

The public is aware of the willingness of General Grant to assist in this great work, under such conditions of organization of a company and of a concession as would enable it to be prosecuted vigorously and effectively. He has given the subject his careful attention for years; is well satisfied as to the route, which possesses a certainty of realization by development; he appreciates fully the great importance of the construction of the ship canal for the commerce of the world, and especially for the full development of our West Coast.

It is gratifying to observe that there is an universal expression of opinion as to the advantage which the construction of the canal would derive from having General Grant at its head. The expression is unanimous that it would ensure an economical, intelligent, and vigorous prosecution of the work, and its completion within the shortest time, and that it would have all of the conditions of practical utility and permanency that could be secured.

Recent information, from the most reliable sources, gives the assurance that the intelligent people and Government of Nicaragua are in entire accord with this movement, and instead of embarrassing the question with impossible conditions, will do all in their power to forward the great work.

To sum up the whole matter, we may well desire that our countrymen should know what canal route will best serve the commerce of the world, in which our countrymen are so largely interested. This is eminently a question for the ablest engineers to pronounce upon. Exact information will be presented in a prepared form by Civil Engineer Menocal, U. S. Navy, for discussion by the Society of Civil Engineers

of the United States, showing the quantity of work that will be found necessary on the Panama route at the ocean level, and also by way of Lake Nicaragua, with a lockage of 107 feet above the ocean. It is really not a question of what we may desire, but actually only of what Nature, whose forces are ceaseless and tireless, will permit. To enter into an ill-advised struggle with them is to be defeated in the end, at whatever cost or continued effort. The labor and expense of constructing a ship canal, under the most favorable conditions granted by Nature, will be great, but the result attained will be the grandest that man is capable of achieving for the convenience and extension of the commerce of the world.

Through this discussion we may hope that all of the advantages as well as the difficulties, positive and relative, on those routes, will be fairly developed—not upon fanciful presentations, but upon sufficient information through calculations.

I have taxed your patience in an endeavor to show the present aspect of the ship canal question, and have now only to point to the importance of the forthcoming calculations in detail, and the irrefragable results obtainable from their full and fair discussion.

Gen. Egbert L. Viele, of the Council, then read the following letters :

Letter from Frederick M. Kelley.

[Before reading the letter of Mr. Frederick M. Kelley, Gen. Viele said : Mr. Kelley has spent 27 years' time and over \$120,000 in cash in promoting the success of a ship canal without locks through the American Isthmus, and during that time has sent to the Isthmus seven different surveying parties and procured two governmental expeditions to examine all the feasible routes via the Atrato and San Juan valleys during the years 1852, '53, '54 and '55. The reports of the engineers, Messrs. Troutwine, Lave, Porter, Kennish, McDougall, Sweet and General Michler, who had charge of those surveys, can be seen in the public libraries.]

NO. 153 WEST 45TH STREET, }
NEW YORK, December 7, 1879. }

MY DEAR SIR: Your favor of Nov. 26, inviting me to be present at the meeting of your Society on the 9th to hear Admiral Ammen's Nicaragua Ship Canal paper read, I received in due time, with thanks; but on account of serious illness in my family I will not be able to attend.

I would be very glad to see the Admiral, as it was my good pleasure to make his acquaintance some years since in Washington; notwithstanding I have no confidence in the enterprise of which he is so zealous and able an advocate.

Twenty-seven years' study of the question, and an extensive intercourse with men engaged in shipping interests in this country and Europe, have convinced me that a *short sea level canal*, with good, safe harbors, which will require no dredging or other improvements to keep open, and which can be reached safely at all times on a wide, open sea, is what the commerce of the world demands, and will have sooner or later, cost what it may.

These important and necessary conditions the Nicaragua route does not afford, as it is 180 miles long, requires 18 or 20 locks, so liable to get out of order in the wet, decaying Isthmus climate, and has no good natural harbors on either ocean.

A canal via the San Blas route will give us a deep, wide cut through the narrowest part of the isthmus, through which vessels may pass from ocean to ocean quickly and cheaply on an even keel, without the expense, dangers and delays of locks, save one tidal lock to control the high tides of the Pacific.

A ship, at the rate of three miles per hour, could be towed through the San Blas canal in 10 hours, and thus 100 going from the Atlantic to the Pacific, and 100 from the Pacific to the Atlantic, 200 ships could pass the Isthmus at this narrow point in 24 hours with perfect ease. The same ship going at the same speed would require 70 hours to pass the Nicaragua canal, including delays at its numerous locks, even one of which, if disabled, would detain the ship no one can tell how long—perhaps weeks or months. It would be a great misfortune to build a long, many-locked canal like the Nicaragua, as that would result in constructing another one at the narrowest part of the Isthmus.

The San Blas route surveyed by Messrs. McDougall, Sweet, Foreman, Rude, and Fountain in 1864, and *partially* examined by Commander Selfridge in 1871, is but about 30 miles long, of which 10 miles is the Bayano river, easily, for a trifling expense, made navigable for ships, thus leaving only 20 miles for canalization. Of this, however, 7 miles is a tunnel, which the engineering skill of this day, with steam and compressed air drills now in use, can drive, without serious difficulty, the same as they have the Hoosac, Mont Cenis, St. Gothard, and other tunnels in this country and Europe, which, 25 years ago, with the old mode of hand-drilling, would have been thought impracticable.

In attempting to solve so great a problem as the best and only route for a ship canal, it is important that additional surveys should be made, especially of the San Blas route, which is much the shortest of all proposed, as by this means a lower and

shorter pass will doubtless be found by flanking the sugar-loaf shaped hills which extend through that part of the Isthmus.

The party should be in charge of a competent army officer like General N. Michler, who, in 1858, by order of Congress, made the very creditable and able survey of the Atrato Truando route for a canal without locks, via the Atrato Valley.

As we are building the canal for all time, and to satisfy the ever expanding wants of commerce, it is the height of folly to locate it where dangerous floods and almost bottomless swamps will destroy it, and thus render useless the undertaking which has cost millions of money.

The safest and most reliable material to excavate in that country is rock, and the *more miles of rock* the canal passes through the more safe and durable will be the structure, the less walling will be required to keep the banks from falling in, and the less will be the cost of maintenance after the work is finished.

Of about 30,000,000 of cubic yards of materials to be removed on the San Blas route (which is much less than on any other route excepting the Atrato-Napipi), about 25,000,000 is rock, and hence the canal located there would be more safe and solid, and cost very much less to maintain it in the future.

This, in the long run of years, is of very great importance to the stockholders, as every railroad man in the country fully comprehends. If it costs all the receipts to maintain the work, where will the shareholders get their anticipated dividends? I have had careful estimates made by the engineers employed, and the total estimate of the cost of the canal is \$104,000,000. The estimate of cost of the tunnel, 80 feet wide at the water line, and 120 feet high from the bottom of the canal, is \$54,000,000.

Yours, very truly,

FREDERICK M. KELLEY.

CHIEF JUSTICE DALY,

President of the American Geographical Society.

Letter from Nathan Appleton.

NO. 10 COMMONWEALTH AVE., BOSTON,
December 3, 1879.

CHIEF JUSTICE DALY,

President of the American Geographical Society.

DEAR SIR: I beg to acknowledge, with thanks, the receipt of your letter informing me that Admiral Ammen is to read a paper before the Society, at New York on December 9, on the Nicaragua canal question, and inviting me to take part in the discussion that will follow it.

It will be impossible for me to be there, as I have an engagement at Washington on the following day, to attend the quarterly meeting of the United States Board of Trade.

All I could say would be to vindicate the earnest efforts and the honest intention of the International Congress held at Paris last May, under the presidency of M. Ferdinand de Lesseps, to decide upon the best route for a canal across the American Isthmus.

I certainly believe that its decision in favor of a tide level canal by Panama was the right one. I think that, if the same Congress should meet again and discuss the question for a month instead of a fortnight, it would come to exactly the same conclusions. Moreover, I believe that if an American Congress should be convened at New York, it would arrive at this result, which is, that the only canal which can respond to the demands of commerce is a straight cut from ocean to ocean, without locks, and without a tunnel; and for this the only place thus far known, on the long stretch of the American Isthmus from Tehauntepec to Napipi, is at Panama.

The line which was selected by American engineers for a railroad, thirty years ago, stands unchallenged to-day as the best place for that other road of travel and communication—a canal.

I see no difficulty in building a canal by Nicaragua, nor would its expense be very great; but I contend that when it is done, with its seventeen locks, more or less—a great ascending and descending water staircase, to utilize the reservoir of the Lake of Nicaragua—it will be a mere curiosity of engineering, but of no practical use, for it will not enable a sufficient number of ships to pass through it per day to encourage them to make the attempt.

I am not willing to accept this as the “American plan”; for I say it is paying a very poor compliment to the intelligence of our people to suppose that they will endorse any but the best project for a ship canal.

The engineers who have been examining the line by Panama since the decision of the Paris Congress declare that the difficulties in the way of a canal there are less even than they had imagined.

When M. de Lesseps shall have gone there and looked at the ground himself, as he proposes to do very shortly, if he, too, states that a tide level canal is possible at Panama, as he has proved it to be at Suez, then I suppose the world will accept his decision.

We can congratulate ourselves upon the interest General Grant takes in the canal question; and you can judge how much M. de Lesseps counted upon his co-operation, for he offered him the first honorary presidency of his company—the only possible position he could offer in a company which had no legal existence—as the most conspicuous citizen of our land.

If these two great men will work together to build a canal in the right way and in the right place, there is little doubt but that it will soon be finished.

The canal opened through the American Isthmus must be the highway of the world, secured by absolute neutrality. There should be no national jealousy as to which nation will take the initiative in building it; but how can it better be done than by the joint action of the people of the two great republics on either side of the Atlantic ocean—France and the United States?

As I cannot attend your meeting, I desire to present the following resolution by letter:

“*Resolved*, That the American Geographical Society takes proper steps to give M. Ferdinand de Lesseps a fitting reception on his arrival at New York, and that he be invited to deliver an address on the subject of the Interoceanic Canal.”

Asking you to read this letter, if possible, at the meeting, I have the honor to be

Very truly yours,

NATHAN APPLETON.

Letter from Walton W. Evans, C. E.

The following letter from Mr. W. W. Evans, member of the Council, was preceded by one to the President of the Society, in which Mr. Evans expressed his conviction that the San Blas route was preferable to the Nicaragua and Panama routes, in which he states that he agrees with M. de Lesseps that the canal to be built should be a tide water, or sea level canal; and that, to be safe, reliable, and at all times ready for quick transit, it must not be on a line of drainage, in such a country as the Isthmus—a region where, for more than half the year, the heavens pour down floods of water. He told M. de Lesseps, in Paris, that he never could build the canal on the Panama route, as proposed by the Congress, and says that when M. de Lesseps reaches there he will find the physical conditions very different from those on the Isthmus of Suez, where he had a rainless region, and was required simply to dig in the sand, with no obstructions in vegetation, or rivers to contend with. In our Isthmus, on the contrary, there must be encountered continuous floods of rain, rock covering nearly the whole distance, and vegetation so dense that one can scarcely see into it, with which are united pestiferous influences from insect life and other causes. Mr. Evans calls attention to the fact that earthquakes occur nearly every day there, and says he thinks that this earthquake element has not been duly considered by Admiral Ammen and others, who advocate a canal with locks. He has seen houses so twisted by earthquakes that no one could open or shut a door in them; and what, Mr. Evans asks, would be the efficiency of a canal, if the locks became so warped that no power could open or shut the huge gates that would be required?

Mr. Evans says further in this letter, that he has had seven years' experience in canal building; that he has crossed the Isthmus at Panama many times, and lived in earthquake countries; that he has studied the subject of a canal across the Isthmus for more than thirty years; and flatters himself that he knows as much of what is required as most of the gentlemen who are now discussing the question.

Having been requested by the President, in consequence of this letter, to attend the meeting of the Society at which Admiral Ammen's paper was to be read, Mr. Evans being prevented from doing so by illness, sent the following letter. Before reading the letter, Gen. Viele said that, being himself an engineer, he deemed it proper to say that Mr. Evans was considered by the profession one of the ablest engineers of the country.

SANS SOUCI, NEW ROCHELLE, N. Y.,
December 5, 1879.

Chief Justice DALY,

President of the American Geographical Society.

My Dear Judge: I received your kind note of Nov. 23. I am still troubled with a terrible catarrh in my throat, and when I venture out I have added asthma, and then can hardly move. As long as I remain in the house, I am pretty well. I will try to write my opinion in reference to the Interoceanic canal, so it can be read when the matter is discussed before the Society. I was invited by M. Lesseps to be a deputy at the Paris Congress. I was in Berlin, but excused myself from going by saying that I could not hear anything, so I could not join in the discussion, but I would write a paper, or rather a letter, to my brother-in-law, M. C. A. von Hernert, who lives in Paris, and was a delegate to that Congress. I wrote it hurriedly and sent it. I never knew if it was read or not. I sent a copy of it to Mr. Evarts, but I do not know if he read it or not. I will look up this letter and send it to you to read. I consider this canal the most important matter in the line of progress that is now before the world; it is of vast importance to England, but it is of still greater importance to the United States. England cannot much longer keep her eyes shut to the injury the Suez canal is doing towards destroying her grip on the trade of the world, and I fully believe in the truth of the remark made by Michel Charlier, that the Suez canal was an artery that if kept open would bleed England to death. Her only power to counteract this influence is to join us, and cut the Isthmus canal. I see by the papers that the influence of Admiral Ammen, backed by Gen. Humphreys and Carlilo Patterson, will be so great that it is a matter of difficulty to counteract it, but I would like to have my opinion in the matter put on record in our Society; it can be summed up in a few words; it is this—that a canal built on the Nicaragua route will

be when finished a total failure, and all the money invested in it utterly sunk, for the day is not far distant when the trade of the world will demand that a canal be built between the two oceans on the shortest route, and on the most direct line, regardless of the difficulties that may be encountered. This route is the "San Blas route." It is acknowledged to be the route by Totten, Troutwine, and Sweet, all old canal engineers, who have lived on the Isthmus and know it well, and this is also the opinion of Mr. Kelley, who has spent a fortune in surveys to find a proper route for this very canal. I hope in a few days to be able to put this matter in better shape for you to read to the Society, but I wish here to say that if we now turn our backs on the San Blas route in fright, merely because it calls for a big tunnel to be cut, and because it may possibly cost in first outlay a little more than the Nicaragua canal, we will in a few years be ashamed of ourselves, and confess that we had not a quarter of the pluck the Spaniards had two hundred years ago, when they cut the "Desaguadero" in Mexico, a work that called for the excavation of three and a half times as many cubic yards of rock as would be required to cut a ship tunnel ten miles long, 160 feet high, and 80 feet wide. Our weak-kneed people, who get frightened at the idea of a tunnel, should go to Europe and study tunnelling as done there. I found over 200 tunnels between Nice and Spezzia, on the edge of the Mediterranean, cut and used for a very limited railway travel.

The line of the St. Gothard railway is a perfect marvel for tunnels. Nearly one-fourth of the whole line is in tunnels. The great or Summit tunnel is $9\frac{1}{2}$ miles long; and in seven places on the line—three on the Swiss side of the St. Gothard and four on the Italian side—they have tunneled into the sides of the mountain in great entire circles of 1,000 metres diameter merely to get distance and keep the line to their fixed maximum gradient of 1 in 40, or say 132 feet to the mile. And what is all this terrible expenditure for? Why, merely to rehabilitate the trade which the Suez canal has opened for them, and which the people of the Mediterranean enjoyed, and out of which they built their great cities and filled them with wealth up to the time when Vasco de Gama discovered, four hundred years ago, the route to the East by the Cape of Good Hope. England made this route her own, and out of it she made herself the mistress of the seas, the storehouse of Europe, and the richest country in the world. The time has come for a new deal: the centres of trade are seeking new homes; the gold and silver of the western slope and the cereals of the eastern slope of America are becoming elements in the great problem of moving and fixing the money granary of the world. Bishop Berkley was prophetic when he claimed that the course of empire traveled towards us; and so was the English poet Webb when he wrote, fifty years before our Revolution, the lines—

"Rome laments her ancient fame declined,
And Philadelphia becomes the Athens of mankind."

I beg pardon for letting my pen run at random over five sheets. I commenced at first merely to say that I could not come to the meeting of the Society's Council to-morrow, as I dare not trust my throat in the cold.

Yours ever sincerely,

W. W. EVANS.

At the conclusion of this reading the President of the Society, CHIEF-JUSTICE DALY, said :

It has been said, as I am informed by M. de Lesseps, that the late Emperor Napoleon was in favor of the Panama route. I received a letter this afternoon from our Fellow, Mr. Samuel B. Ruggles, who, as the Society knows, has paid great attention to the subject of canals, which letter was accompanied by an extract from an address delivered by Mr. Ruggles some time ago, in which it is shown that the late Emperor was in favor of the Nicaragua, but not of the Panama route, in proof of which Mr. Ruggles quotes in his address several passages from a pamphlet published by Louis Napoleon, to which Mr. Ruggles requests me to call attention this evening. There is not time at present to read all that Mr. Ruggles has submitted, but it will be printed with the proceedings of the meeting. We have invited several gentlemen to be present this evening who have made the subject of this interoceanic canal an especial study. We have with us Mr. Menocal, who was a delegate to the Paris Congress ; Mr. Bogart, the Secretary of the Society of Civil Engineers ; Mr. Gardner, the head of our State Survey ; Signor de Franco, of Nicaragua, and Mr. Frank de Y. Carpenter. I do not know that any of these gentlemen are prepared to make any remarks, but I think the Society would be gratified to hear observations from any one of them upon the paper and the letters that have been read. I confess to have been impressed with the statement of Mr. Evans, that the earthquake element has not been duly considered by those who advocate the construction of a canal with locks, and as there are several gentlemen here who must know a great deal about the effect of earthquakes upon the Isthmus, I think we would all be very much gratified to know what they think of this objection. I should also say, in this connection, that Mr. Evans transmitted to me to-day a copy of a long letter in favor of the San Blas route, addressed to a member of the Paris Congress, which letter we will publish in our Bulletin. He accompanied this communication with a private note, containing a remark which I

think I may take the liberty of quoting. It is this : "I have given my opinion as to the best route against my own private interest, and have no interest of any kind in the San Blas route." I will now take the liberty of asking Mr. Menocal what he thinks of Mr. Evans' objection, that the constant occurrence of earthquakes will have the effect on the Isthmus of warping, dislocating, or rendering otherwise unmanageable the heavy wooden gates of locks, and would add, that we would like to hear from him upon any of the questions involved in the consideration of this subject, for there is no gentleman present whose opinion is entitled to greater weight.

Responding to the invitation of the President, Mr. A. G. MENOCAL, Civil Engineer, U. S. Navy, said :

I am not prepared to make a speech in regard to the Nicaragua route, or any of the routes, but I will try to answer some of the objections raised by the letters just read. In regard to the earthquakes, I have to confess that earthquakes are very frequent in Nicaragua, but they are only slight shocks, that never did any damage to life or property, or in any way altered the levels of the waters in the lakes, rivers, and wells. And, I would ask, what damage could such earthquakes do the locks of a canal that would be of such serious character as to be regarded in the light of affecting the questions of the construction and maintenance of the work? It might crack the walls, but that damage could be easily repaired. But what effect, on the other hand, would earthquakes have upon such a tunnel as that proposed on the Panama route,—one an hundred feet wide and one hundred and sixty-eight feet high, as proposed. And we have them very near Panama sometimes. Only a year ago they had an earthquake in Santandea, where a whole town was destroyed, and fifteen hundred lives lost by it.

In regard to the objection of Mr. Appleton, concerning the locks necessary on the Nicaragua route, all admit that a tide lock will be a necessity of the route he advocates, and this will restrict the capacity of the canal as much as any number of locks along the route. If it takes a vessel an hour to go through the tide lock, it will take a dozen hours for twelve vessels to pass, irrespective of what the conditions beyond may be.

With regard to the liability of locks to get out of order, I think the American engineers are the ones who should speak least of that

objection. Locks are in constant use on the canals of England, of Holland, of France, in fact all over Europe and in this country, and their working is no longer a thing of speculation and theory. The locks have been in use a great many years in the North Sea canal, and the engineers of that canal, though friends of M. de Lesseps, and advocates of a sea level route for an interoceanic ship canal, admitted that they could pass a ship every hour through the locks proposed on the Nicaragua route. That would carry all the tonnage through the canal that will be wanted.

The Nicaragua canal, I claim, could be built for one-third as much as that by the San Blas route ; not that I admit that the latter is practicable, but assuming for the present the claim of its advocates that it is. I think, from an engineering point of view, that the San Blas route is impracticable ; but suppose its difficulties could be overcome, it would cost three times as much as the Nicaragua canal, which will answer all the demands of trade just as well. Of the latter, nature has provided a great part already in lake and river, in which a steamer can go at full speed, and the portion remaining, the sixty-one miles of canal that will have to be constructed, is what should, fairly, be compared with the San Blas route. On that portion, sailing vessels will have to be towed, but so will they on the other. On Lake Nicaragua they can take advantage of the winds, the same as if at sea. But, in considering the San Blas route, the long towage out of the Bay of Panama to the Pacific must be taken into account, and should properly be added to the estimated length of that canal. It may be all very well for vessels that pass through, but what about vessels coming to the canal from the Pacific side ? How are they to convey an intimation, upon their arrival at the bay, to the canal officials, that they desire to be towed in ? It would be necessary to keep steam pilot boats constantly on the look out for such vessels. The difficulties of navigation on the San Blas route would be at least equal to those on the Nicaragua route.

CHIEF-JUSTICE DALY : How about harbors at either end of the Nicaragua route ?

MR. MENOCAL : We would have to build two harbors, one at each end of the Nicaragua route, but their expense would not be very great. The item of harbor improvement is covered in the estimate stated by Rear-Admiral Ammen. The plans have been submitted to several commissions of engineers, and fully approved,

and the Paris Congress approved of them entirely, without any criticism.

I have no doubt that when M. de Lesseps arrives at Aspinwall, the information he will there receive concerning the recent floods of the River Chagres, will satisfy him of the impracticability of the Panama canal. As I stated at the Paris Congress, that river sometimes rises thirty-six to forty feet above the level of the sea at low water. The effect of this has already been clearly stated in Rear-Admiral Ammen's paper. When I stated this fact at the Paris Congress, it was doubted, and I was asked if my information was from actual surveys, or was only gleaned from the statements of the natives. It was, I said, from actual surveys; yet they insisted that the River Chagres only rose seven metres. Now, they can satisfy themselves of the fact that I stated. During the last flood the river has risen forty feet. The town of Gatun was partially carried away, and parts of the railroad were submerged to a depth of several feet, during eight or ten days, by the floods.

I might remark on the difficulty of building a tunnel such as will be required on the San Blas route; but a discussion of the engineering difficulties to be apprehended would take a long time and hardly be understood. The great difficulty will be the making of excavations below the level of the sea. I have very carefully examined what takes place in the wells, and in the gold and silver mines and other excavations in that country, and I say that as soon as we reach about one hundred feet below the surface of the ground, the filtrations become so great that many of the richest silver mines have to be abandoned, because pumps could not be obtained of power and capacity sufficient to keep them dry. Through the loose disordered masses, the results of volcanic action, that make up the Isthmus, water filtrates with the greatest ease everywhere, and in great quantities. At the summit of the Panama railroad, its highest point, which is 282 feet above the level of the sea, there is a spring of water that supplies all the engines on the road, and in addition so far exceeds the demands upon it, that it runs down the gutters on both sides of the road.

What then will be the effect of digging below the level of the sea? From my knowledge of the geological formation of the Isthmus, I believe that, so far from encountering solid and regular strata, as they suppose, they will meet with all kinds of materials—limestone, trap-rock, sand, conglomerate volcanic deposits—every-

thing, indeed, without regularity, and in the most bewildering variety, even within the narrowest limits. I have seen workmen there, in the digging of a well to a depth of no more than fifty feet, go through ten different kinds of materials.

CHIEF-JUSTICE DALY : Do you know the character of the rock through which it is proposed to cut the tunnel on the San Blas route?

MR. MENOCAL : I cannot say I know it positively, further than my well-grounded knowledge of the geological formations generally throughout that country assures me that, instead of one regular and consistent character of rock, will be found many different varieties. It has been said that the mountain through which the San Blas tunnel is proposed, is a solid mass of granite, but that I believe to be an error, and I should not be surprised if we found there a soft limestone, such as we find at the headwaters of the River Chagres, not far from that route.

The President then called upon Mr. JOHN BOGART, Secretary of the Society of Civil Engineers, who said : I think the majority of the engineers are still wanting a little more information in regard to the Panama and San Blas routes. The surveys made by Mr. Menocal at Nicaragua have been very full, and we are thoroughly well informed as regards the difficulties to be met there, and the modes proposed for overcoming them, but, certainly, as has been shown by Mr. Evans's letter, the idea of a direct short route from ocean to ocean, strikes engineers as an excellent solution of the problem. The thing in the way is this great tunnel. It certainly is practicable for engineers to discover—if we can get, as Mr. Kelley suggests, a proper survey of the San Blas route—just what the character of the rock is. We hardly like to say that it would be impracticable to put a tunnel in there. It is a question, of course, of possibility, and therefore I think that most of us agree with the suggestion made by Mr. Kelley, that before we positively decide on this matter, we ought to know more thoroughly the character of the rock at the San Blas crossing of the range. The subject is large enough, I should say, Mr. President, to be discussed when we have more time. There are several engineers ere in the audience, whom I see, who, I am sure, could give us an interesting discussion of this subject, but it is rather late to-night to call on them.

Mr. T. Bailey Myers moved that the discussion of this important question be continued by opening the rooms of the Society for that purpose on stated evenings, to be hereafter assigned.

In putting the motion, CHIEF JUSTICE DALY spoke as follows:

The Council having felt that, as this is a great international question, in the proper disposition of which we have as deep an interest, and perhaps deeper than any other nation, it is the duty of the American Geographical Society to acquire and diffuse as much information as can be procured, and to have the question of the best route discussed, as far as it can be, upon the ascertained facts. With this view, it is the wish of the Council to continue the discussion at the rooms of the Society, where, without any present limits as to time, the fullest opportunity can be afforded for the expression of views, and where everything that is said can be taken down and published in our Bulletin. This duty seems especially to devolve upon us more than any other American institution, for the reason, among others, that we have greater facilities than any other body in the country, with perhaps the exception of the Smithsonian Institution, for disseminating throughout the world the information elicited by such an investigation. We appreciate the necessity for, and therefore propose, having a more full examination of the comparative merits of the different routes than took place at the Paris Congress, which, I am free to say, was hardly a discussion at all; in which a very positive conclusion was declared by a vote of the majority of the body, with certainly very little preliminary investigation. We, on the contrary, think that it is a great, important and practical question, in which every opportunity should be offered for a more thorough examination and discussion of it than has yet taken place, and it is our purpose that this shall be done, as far as it is in our power to accomplish it. We intend, therefore, if the body of the Society approve, to continue what we have commenced to-night at the rooms of the Society, upon stated evenings, until all that can be done in this way has been done, assuming that those only will take part in it who have made the subject a matter of special investigation, who have some information of practical value to communicate, or views to express upon the ascertained facts; that it is not to be limited to an oral discussion, but open to the reception and consideration of any written communications upon the subject that any one may think proper to make. The question to be first settled—which is the most practicable route, under all the circumstances—is, in my judgment, a question for civil engineers and physical geographers, and not for congresses.

Such a question is not in a condition for final decision until all the explorations and surveys have been made, which the present state of our knowledge indicates should be made. We have done more in the way of explorations and surveys to ascertain the best route for the canal than any other country, at least so far as respects the cost, completeness, and value of the surveys, and we are naturally, therefore, not very much impressed—I say it in no spirit of discourtesy—with the action of a body coming together at Paris under the name of an International Congress, undertaking to dictate for the whole commercial world exactly where the canal shall be built, upon the report of two naval officers. I say this not in review of reports by Lieuts. Wyse and Reclus, or of the route adopted by a vote of the majority of the Congress, but simply as dissenting from this mode of attempting to foreclose all future inquiry upon the subject, and to give, by a preliminary proceeding of this nature, a kind of international sanction to the inauguration of what was simply a commercial enterprise. When it shall be fully and exhaustively ascertained what is the true route, in view of the general interest of commerce, the facilities for the construction of the canal, the outlay that will be required to make it a satisfactory and permanent work, and what security it may reasonably be expected it will afford for the capital invested in it, and for a moderate interest upon that capital—when, I say, all this is ascertained, the question of the canal will be settled without the instrumentality of international conventions or congresses, for the commercial world is pretty well agreed upon its utility, and the conviction is now very general that every year of the world's progress will but render more apparent its indispensable necessity. When all the information that can be gathered is obtained and duly weighed, commercial sagacity will determine whether the canal should be built, and where it should be built, and if it is to be, commercial enterprise will, in my judgment, find the means of doing it. This, as I understand it, is the American view of the question, and we are a practical people, accustomed to handle great enterprises, and in doing so, to possess ourselves first of all the facts before deciding what to do.

On motion of Mr. Jas. T. Gardner, seconded by Mr. Francis A. Stout, a vote of thanks was tendered to Rear-Admiral Ammen for the paper furnished by him, and a copy requested for publication by the Society. Carried.